(12) UK Patent Application (19) GB (11) 2 400 907 (13) A

(43) Date of A Publication 27.10.2004

(21) Application No: 0309480.2

(22) Date of Filing: 25.04.2003

(51) INT CL[7]:
A61B 5/00 // A61B 5/024

(52) UK CL (Edition W):
G1A AAMH AR7

(56) Documents Cited:
EP 1297784 A1
EP 0759284 A2
EP 0172747 A2
US 6080110 A
US 3867950 A

(58) Field of Search:
UK CL (Edition V) G1A
INT CL[7] A61B, G08C
Other: online: WPI, EPODOC, PAJ.

(71) Applicant(s):
D4 Technology Limited
(Incorporated in the United Kingdom)
5 Pondside Terrace, Pondside Lane,
BISHOPS WALTHAM, Southampton,
SO32 1BB, United Kingdom

(72) Inventor(s):
Michael John Tudor
Nicholas Robert Harris
Neil Maurice White
Stephen Paul Beeby

(74) Agent and/or Address for Service:
Page White & Farrer
54 Doughty Street, LONDON, WC1N 2LS,
United Kingdom

(54) Abstract Title: **Electro-optical pulse rate monitor with data transfer between monitor and external device via the optical sensor**

(57) An electro-optical pulse rate monitor 6 (for attachment to a users ear) includes a sensor 8 comprising an emitter 12 and a detector 14, an output device 24 for communicating the heart rate to a user, a data storage device 20 for storing measured data and/or operational parameters of the monitor and a data transfer device for transferring data between the data storage device and an external unit 4 via the sensor 8. Hence communication between the monitor and base station occurs via the optical emitter 12 and detector 14 of the pulse rate sensor. Communication may be either unidirectional (to download data from the monitor 6 to base station 4) or bidirectional to both download data from the monitor 6 to base station 4 and to send programming instructions to the monitor 6 from the base station 4). Data may be processed in the monitor and an audio output provided to the user, and may also be stored for later down load to the base station. The monitor is powered by a rechargeable battery 10, waterproof, and may include a number of additional devices (e.g pedometer, GPS). The monitor can be used to monitor the heart rate of a human or an animal (e.g. a racehorse).

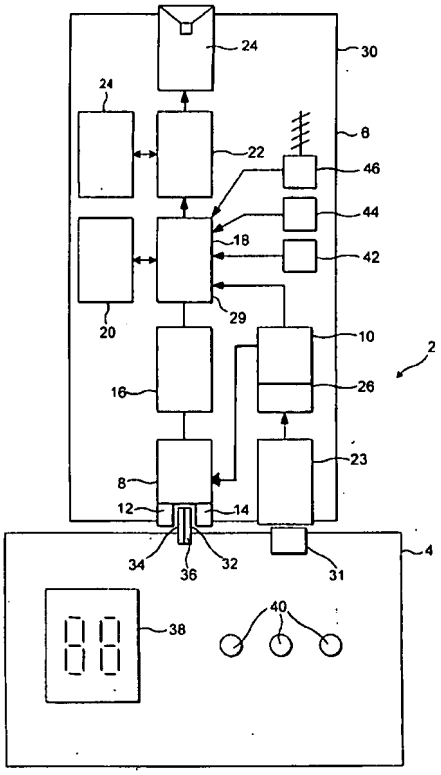

FIG. 1

GB 2 400 907 A

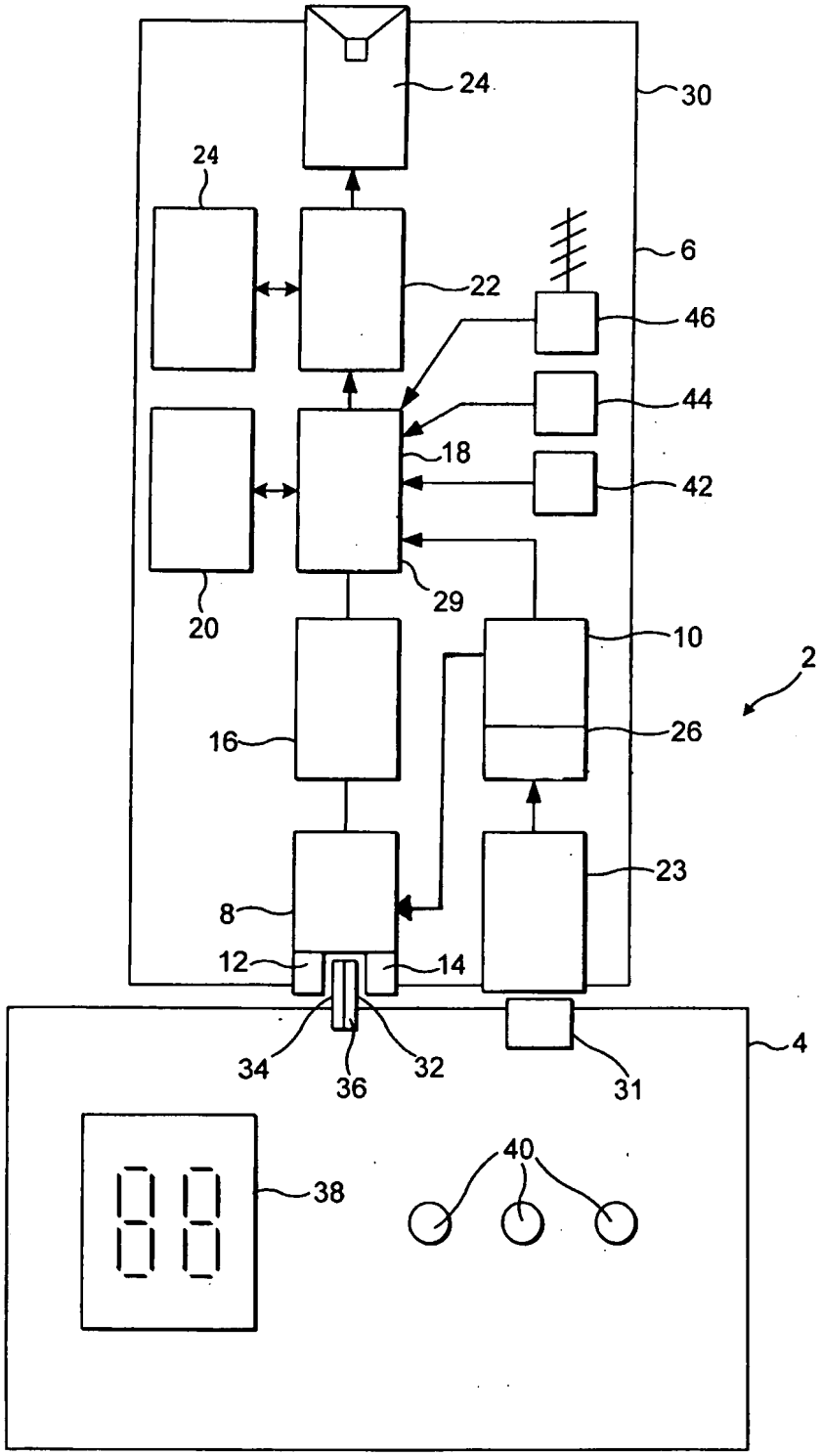

FIG. 1

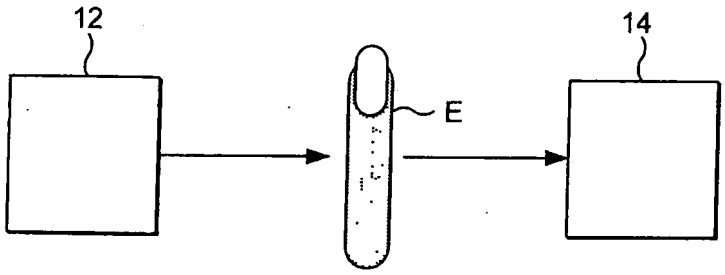

FIG. 2

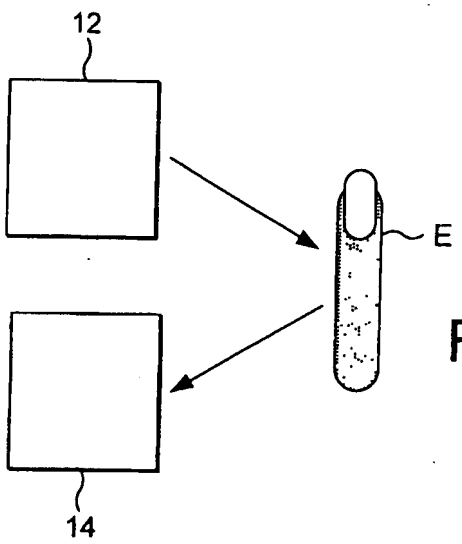

FIG. 3

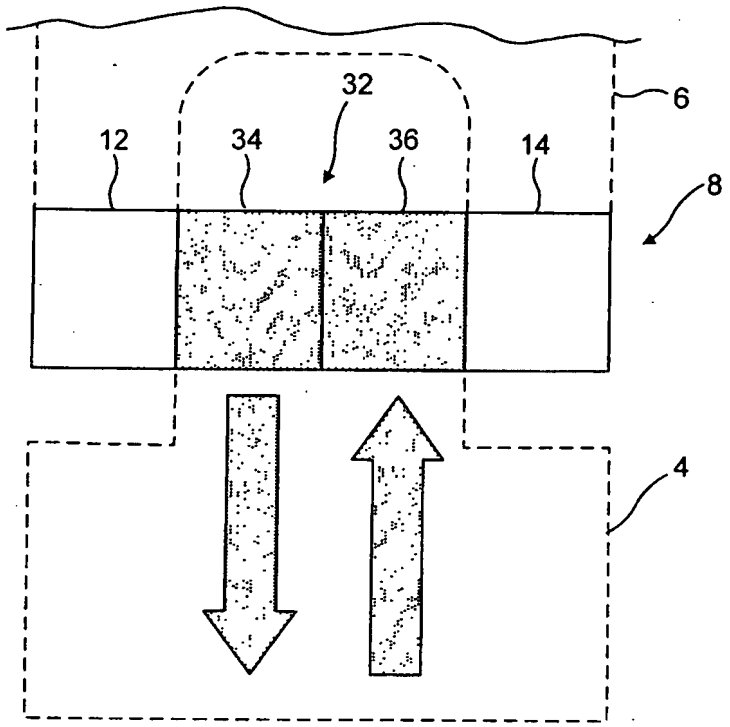

FIG. 4

PULSE RATE MONITOR AND USE THEREOF

This invention relates to a pulse rate monitor and to the use of such a monitor.

Pulse rate monitors for measuring the pulse rate of a user are well known in the art. A number of known pulse rate monitors have been provided which are structured mechanically so as to be convenient to use. For example, some known pulse rate monitors are in the form of an ear lobe clip or finger clip. These monitors typically detect the pulse rate of the wearer by electro-optically detecting any variation of blood flow rate in capillaries positioned between a light emitter (typically a light emitting diode) and a light detector (typically a photo diode). However, such known pulse rate monitors still suffer from the problem of a lack of versatility or functionality in use.

For example, US-A-4334544 discloses an ear lobe clip with a heart beat sensor having the construction of a general electro-optic ear clip for the measurement of pulse rate. Two wires, one for the emitter and one for the detector, extend down from the ear clip along the head of the user and are ultimately connected to a controller or heart beat read out on an exercise device. Not only do the wires render the clip inconvenient to use, but also the clip has only limited functionality by simple connection of the clip to a controller or read out for display of the detected pulse rate.

US-A-6080110 similarly discloses a heartbeat monitor for wearing during exercise in which a pulse rate sensor fits into one ear of the user and a headset with a speaker emits voice synthesised messages indicating heartbeat rate to the user's other ear. Again, wires are required to hang down for connection to a controller worn on a belt around the user's waist.

EP-A-0172747 discloses a pulse rate monitor which uses an electro-optic based sensor located on the ear with an associated speaker audibly indicating pulse rate directly to the ear. The monitor includes memories for storing pre-programmed information on different age groups of users and pulse rate thresholds. The monitor can audibly inform the user, for example using artificial voice signals, of the load of exercise that he is taking for his age rank. While the disclosed monitor is more convenient to use than the clip of US-A-

4334544 and the monitor of US-A-6080110 because no wires are required to extend from the monitor, nevertheless the monitor still suffers from the problem of limited functionality.

US-A-6159130 discloses a telemetric measuring system particularly for use with a heart rate monitor. The heart rate sensor attached to the user, typically by a chest band worn by the user, transfers data wirelessly by means of radio frequency electromagnetic waves to a data collection unit which is in a holder attached to an exercise device. A number of other sensors can additionally be provided for sensing and correspondingly transmitting other data (for example the speed and cadence of an exercise bicycle) to the data collection unit. This system suffers from the problem that there is a potential for radio interference between the user's chest strap and other nearby users – when using the system in a gym, there may be many simultaneous users of the same system. The system cannot be used underwater, even though swimmers represent a significant portion of the personal training market. The chest strap is inconvenient and uncomfortable. The system has a lack of ease of use because of the need for the user to break concentration to look at the readout and also requires a conductive contact with the chest.

GB-A-2284060 discloses a heart rate monitor similar to that of EP-A-0172747 which is fitted to the ear and provides audible information about the monitored condition (i.e. heart rate). The monitor can be preprogrammed with heart rate limits. It is disclosed that, if desired, the monitor may have the facility to record the carrier's heart rate, and for such recording to be played back into a computer for example, for more detailed analysis. However, there is no disclosure of how this is achieved. It is also disclosed that one sensor in the form of a transducer may be separate from the main unit and send signals about the monitored body condition to the controller, by wire or radio signal. This latter modification would result in the problems discussed above.

GB-A-2165352 discloses a heart rate monitor including a sensor for mounting on the ear of a user, the sensor being connected by a wire to a control and display on an exercise bicycle.

GB-A-2103787 discloses a heart rate monitor including a sensor for mounting on the ear of a user, the sensor being connected by a wire to a control on a belt for wearing around the waist of a user.

US-A-4807639, US-A-5807267 and EP-A-0733340 all disclose heart rate monitors which detect the pulse rate of the user at the wrist or finger and display the detected rate on a display device worn about the wrist like a wristwatch. These monitors are inconvenient to use because the user need to break concentration, exercise rhythm and move his wrist to look at the readout on the display device.

US-A-4353152 discloses a pulse rate monitor for use while exercising which includes a finger clip connected by a cable to a display comprised in a package essentially the size of a small hand held calculator. This monitor is inconvenient to use.

JP-A-10118038 discloses a heart rate monitor in which the heart rate of a person to be measured is sequentially calculated by a heart rate computing means based on a time difference between reference points indicating a specified amplitude value of a photoelectric pulse wave detected by a photoelectric pulse wave sensor and digital signals corresponding to nomination sounds of the heart rate are selected and arranged from among those corresponding to voices of as stored in a voice synthesising circuit.

US-A-3815583 discloses a pulse monitoring system for automatically monitoring the heart pulse rates of a plurality of patients. Ear lobe sensors for individual patients each include a radio transmitter for transmitting a signal to a receiver of a controller incorporating an alarm and a display. The problems of the use of radio transmission in a completely different context of heart rate monitors for use during exercise, rather than by essentially immobile hospital patients, are discussed above.

An aim of the present invention is to provide a pulse rate monitor which overcomes at least some of the problems of the known devices described hereinabove.

It is a further aim of the present invention to provide a pulse rate monitor which has greater versatility and/or functionality as compared to those known monitors.

Accordingly, in a first aspect the present invention provides a pulse rate monitor for detecting the pulse rate of a body part of a user, the monitor including a sensor comprising an emitter and a detector, the emitter being adapted to emit an output signal which in use is incident on the body part and the detector being adapted to receive a signal which, in use, is transmitted through and/or reflected from the body part, the received signal being modulated relative to the output signal dependent on the pulse rate of the body part, an output device for communicating the pulse rate to a user, a data storage device for storing at least one of operational parameters of the pulse rate monitor and measured pulse rate, and a data transfer device, connected between the data storage device and the sensor, for transferring data via the sensor between the data storage device and an external unit.

Preferably, the data transfer device is adapted to download data from the pulse rate monitor to the external unit via the emitter and to upload data to the pulse rate monitor from the external unit via the detector.

The present invention therefore provides the first technical feature of two way communication between a pulse rate monitor and a base station, to enable information and data to be selectively transferred between them. Since the sensor of the pulse rate monitor is itself configured to provide this additional communication function, the device structure is simplified and convenient to operate. There is no need to provide a specific additional connector on the pulse rate monitor to communicate with an interface for transferring information from the monitor to an external device, such as a base station or a computer. This is an advantage in applications where a lot of moisture is present (e.g. swimming) as the sensors can be easily hermetically sealed.

In a second aspect, the present invention also provides a pulse rate monitor for detecting the pulse rate of a body part of a user, the monitor including a sensor comprising an emitter and a detector, the emitter being adapted to emit an output signal which in use is incident on the body part and the detector being adapted to receive a signal which, in use, is transmitted through and/or reflected from the body part, the received signal being modulated relative to the output signal dependent on the pulse rate of the body part, an output device for communicating the pulse rate to a user, a programmable data storage

device for storing operational parameters of the pulse rate monitor and a data transfer device for transferring data to the data storage device from an external unit whereby the operation of the pulse rate monitor can be selectively programmed by a user.

The present invention therefore provides the second technical feature of the pulse rate monitor being capable of being programmed by the user, to enable customisation of the operating mode of the monitor by the user. This enhances the functionality and versatility of the monitor.

The present invention yet further provides the use of the pulse rate monitor of the present invention for monitoring the pulse rate of a human or an animal such as a horse, e.g. a racehorse. When configured for human or animal use, the pulse rate monitor would be shaped to be readily locatable on the relevant body part of the user. For equine use, the monitor would preferably be locatable on the ear of the horse in a secure manner.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a block diagram of a pulse rate monitor in accordance with an embodiment of the present invention;

Figure 2 is a schematic diagram of a first configuration of the pulse rate sensor of the pulse rate monitor of Figure 1, the sensor being configured in a first alternative, transmissive, mode for use in the measurement of heart rate;

Figure 3 is a schematic diagram of a second configuration the pulse rate sensor of the pulse rate monitor of Figure 1, the sensor being configured in a second alternative, reflective, mode for use in the measurement of heart rate; and

Figure 4 is a schematic diagram of the pulse rate sensor of Figure 2, the sensor being additionally configured to transmit data, via the emitter and detector in the sensor, to a detector/sensor module in a base station to which the sensor may be detachably coupled.

Referring to Figures 1 to 3, the present invention relates to a pulse rate monitor system, designated generally as 2, in accordance with an embodiment of the present invention. The system 2 comprises a base station 4 and a pulse rate monitor 6 which includes a sensor 8. The pulse rate monitor 6 is cordless and detachably couplable to the base station

4. During pulse rate detection on a user's body, the monitor 6 is remote from the base station 4, but, as described in greater detail herein, during charging of the battery 10 of the monitor 6 and/or during a data transfer from or to the base station 4 to or from the monitor 6, the monitor 6 is coupled to the base station 4. The monitor 6 is typically structured so to be worn on the user's ear, in a manner similar to a hearing aid, as is known to a person skilled in the art, for example from EP-A-0172747. Although the illustrated embodiment is described with respect to a pulse rate monitor for use on a human, as stated hereinabove however, the pulse rate monitor of the invention may be used to monitor the pulse rate of an animal, such as a horse.

The sensor 8 of the pulse rate monitor 6 includes an electro-optical emitter 12 coupled to an electro-optical detector 14 spaced therefrom, which are in use located adjacent to the ear lobe. The sensor 8 may alternatively be configured to cooperate with another thin region of the body instead of an ear lobe, such as a finger. In modified embodiments of the invention, the sensor 8 may comprise a plurality of electro-optic emitters and detectors. A light path from the emitter 12 to the detector 14 is arranged to pass at least partially through the ear lobe and hence couple with the blood. As is known in the art, an optical signal is sent from the emitter 12 to the detector 14 along the light path. Modulation of the optical transmission intensity in the ear lobe occurs as the quantity of blood within the ear lobe pulses in sympathy with the heart beat. The transmitted light intensity received by the detector 14 is correspondingly modulated.

Figure 2 is a schematic of a first alternative arrangement of the pulse rate sensor 8 configured in transmissive mode for use in the measurement of heart rate. The emitter 12 and reflector 14 are in opposed relation, with a linear light path extending therebetween. Light, sent out from the emitter 12, passes through a thin portion of the body such as an ear lobe E or finger. A fraction of the light is absorbed whilst it is within the body and this fraction varies according to the volume of blood in the thin portion of the body. A secondary effect related to the quantity of oxygen bound to the haemoglobin may also exist. Accordingly, the transmitted light received by the detector 14 is modulated in sympathy with the pulse or heart beat.

Figure 3 is a schematic of the pulse rate sensor 8 configured in reflective mode for use in the measurement of heart rate. The emitter 12 and reflector 14 are in a laterally spaced relation, without a linear light path extending therebetween. Light, sent out from the emitter 12, passes into a portion of the body such as an ear lobe E or finger. A fraction of the light is reflected according to the colour of the blood which will vary with the quantity of oxygen bound to the haemoglobin. This will vary according to whether the blood to outgoing, i.e. carrying oxygen to the tissues, or incoming, i.e. returning to the lungs for re-oxygenation. Therefore the reflected light received by the detector 14 is modulated in sympathy with the pulse or heart beat.

A third alternative arrangement is a device incorporating one detector for transmitted signals and one for reflected signals offering the both of the transmitted and reflected signals for subsequent processing.

The modulated signal data from the sensor 8 is processed by a signal processor 16 and the processed signal is logged by a microcontroller 18, in this embodiment including a microprocessor. The microcontroller 18 receives data concerning preset parameters (for example, heart pulse rate limits) from a data log memory 20 coupled thereto. An output from the microcontroller 18 is conveyed to a voice synthesiser 22. The voice synthesiser 22 receives preset voice commands from a voice memory 24 coupled thereto. The output of the voice synthesiser 22 is fed to an audible output device 24, in this embodiment comprising a miniature loudspeaker mounted in the monitor 6 so to be situated, in use, adjacent to the user's ear. In this way, information in the form of a synthesised voice signal concerning the user's heart rate is relayed to the user in real time. During use, the real time signal is relayed to the user at a specified update rate via the loudspeaker 24. Pulse rate data, for example representing a history of the measured pulse rate over time, can also be stored in the data log memory data 20 of the monitor 6 for later download to the base station 4 and/or a computer (not shown) connected to the base station 4. The pulse rate data can also provide information such as average heart rate, calories burned, etc..

The pulse rate monitor 6 has a rechargeable power supply, designated as 23, comprising a recharge subsystem 24, for receiving an input power supply from the base station 4, and

the battery 10, with associated power converter 26, for powering the sensor 8 and the microcontroller 18. Since many applications, for example swimming, of the pulse rate monitor 6 may require the pulse rate monitor 6 to be waterproof, a non contact method of charging the battery 10 in the monitor 6 is advantageously provided, thereby allowing the pulse rate monitor 6 to have an outer housing 30 which is hermetically sealed, so that the electrical components are protected against water ingress. This is because no jack plug socket (or other electrical connector) needs to be provided in the outer housing 30 of the monitor 6. Most preferably, inductive charging of the battery 10 from a charging unit 31 in the base station 4, or from an additional dedicated charger (not shown), by using AC mains power is employed. However, for accommodating situations where the battery 10 of the pulse rate monitor 6 may need recharging but where a mains power supply for the base station 4 may not be available, the base station 4 may be configured to provide a source of power from an internal battery or batteries (not shown), for example by using a direct wire connection or an inductive charging system.

In accordance with one aspect of the present invention, there is provided a means of downloading to the base station 4 data, relating to measured pulse rate, stored within the data log memory 20 of the pulse rate monitor 6 by using the optical emitter 12 as a data transmitter. In addition, data, relating to operational parameters, from the base station 4 may be uploaded to the pulse rate monitor 6 by using the optical detector 14 as a data receiver. This aspect of the invention accordingly provides for the use of the electro-optical components already present in the pulse rate monitor 6 in order selectively both to download measured data stored within the pulse rate monitor 6 for later display or analysis on the base station 4, or on a computer, and to upload data to the pulse rate monitor 6 in order to set parameters such as, for example, speaker volume, voice output rate or an identification number for the user. The uploaded data can also comprise training programs to be audibly communicated to the user, voice samples, with specific words or phrases and/or specific voices, selected voice packs for specific exercise programs, routines or sports, e.g running, cycling or swimming. The base station 4 may be configured to analyse the downloaded data, such as the pulse rate information, then calculate new exercise profiles based on the analysis and upload them into the pulse rate monitor 6.

Figure 4 is a schematic diagram of the emitter 12 and detector 14 of the sensor 8 of the pulse rate monitor 6 configured in this way for secondary use in data transmission. The housing 30 is detachably attached to a dedicated optical module 32 of the base station 4. The dedicated optical module 32 contains a similar electro-optical detector 34 and emitter 36 pair. The dedicated optical module 32 is adapted to be locatable between the spaced emitter 12 and detector 14 of the sensor 8 so that the emitter 12 interfaces with the detector 34 and the detector 14 interfaces with the emitter 36, whereby, in use, light from the sensor's emitter 12 couples into the module's detector 34 and light from the module's emitter 36 couples into the sensor's detector 14. Thus two way communication can be established with the base station 4 of the pulse rate monitor 6 via its sensor 8 by modulation of the emitters 12, 36 in a known protocol. If a physical connection is not possible, the light can be relayed between the two emitter 12, 36/detector 14, 34 pairs via an optical fibre (not shown) or via free space.

An example of data which it is desirable to download may be a past history of the pulse rate or any other parameter which may be measured by the pulse rate monitor 6 on a living body. In addition, a user may wish to download a previously uploaded identifier of the last user. This data may then be conveniently displayed or analysed on base station 4, in which case the base station 4 may be a dedicated base station 4 consisting of a visual display 38 and controls 40, for example buttons, to change the set up of the pulse rate monitor 6. This base station 4 configuration may be envisaged as analogous to a TV remote control but with two way communication via the pulse rate monitor's sensor and with its own built in display. This data may alternatively be conveniently displayed or analysed on a computer (not shown) coupled to the base station 4.

Examples of data which may be uploaded from the base station 4 to the pulse rate monitor 6 are key operational parameters related to the pulse rate monitor 6 such as speaker volume, voice output rate or user identification. Alternatively or additionally, uploaded data may consist of fitness training programs, new voice samples and specific training programs for the activity in question. These new voice samples may be celebrity voices or the user may generate their own voice files.

The pulse rate monitor 6 may also incorporate a distance measure 42 such as a pedometer or accelerometer to allow automatic calculation of, for example, distance run or swum, or a global positioning system (GPS) receiver 44 to allow accurate monitoring of distance and altitude, together with the pulse rate.

The optical emitter 12 and detector 14 of the monitor 6 may be used in a dual mode i.e. using both reflected and transmitted signals, thereby potentially adding a second measurand such as blood pressure to the primary measurement of pulse.

A loudspeaker based pulse rate monitor of the present invention may conveniently form part of a wireless entertainment system, for example in headphones over which audio entertainment may also be played. Therefore, the pulse rate monitor 6 may further comprise a receiver 46 for receiving a signal from a wireless entertainment system.

The present invention provides a number of advantages as compared to the known pulse rate monitors disclosed in the prior art described herein.

The embodiments of the present invention provide a monitor embodying the concept of using the electro-optic sensor not only to send pulse rate data one way to a display, etc., but also for two way communication with the pulse rate monitor control system, to enable information and/or data to be uploaded to the sensor from a control system. This convenient communication to and from the monitor is not achieved by the known pulse rate monitors, and enables the monitor's operation and features to be customised by the user.

The known pulse rate monitors also do not provide a monitor embodying the concept of downloading logged data via the sensor's emitter or adjusting the pulse rate monitor's parameters by uploading via the sensor's detector. This dual-operation of the emitter and detector is effective and convenient in the preferred embodiments of the invention.

In addition the known pulse rate monitors do not recognise the need for downloading data directly from the pulse rate monitor's emitter to a computer or base station or uploading parameters via the sensor's detector from a computer or base station. This enhances the

convenience and features of the pulse rate monitor of the preferred embodiments of the invention.

All of these technical features greatly enhance the versatility and functionality of the pulse rate monitor of the present invention as compared to the known devices disclosed herein.

Claims

1. A pulse rate monitor for detecting the pulse rate of a body part of a user, the monitor including a sensor comprising an emitter and a detector, the emitter being adapted to emit an output signal which in use is incident on the body part and the detector being adapted to receive a signal which, in use, is transmitted through and/or reflected from the body part, the received signal being modulated relative to the output signal dependent on the pulse rate of the body part, an output device for communicating the pulse rate to a user, a data storage device for storing at least one of operational parameters of the pulse rate monitor and measured pulse rate, and a data transfer device, connected between the data storage device and the sensor, for transferring data via the sensor between the data storage device and an external unit.

2. A pulse rate monitor according to claim 1 wherein the data transfer device is adapted to download data from the pulse rate monitor to the external unit via the emitter and to upload data to the pulse rate monitor from the external unit via the detector.

3. A pulse rate monitor according to claim 1 or claim 2 wherein the emitter is an electro-optical emitter and the detector is an electro-optical detector.

4. A pulse rate monitor according to any one of claims 1, 2 and 3 wherein the data storage device is adapted to store a past history of measured pulse rate measured on a user.

5. A pulse rate monitor according to any foregoing claim wherein the data storage device is adapted to store at least one training program.

6. A pulse rate monitor according to claim 5 wherein the at least one training program is specific to a respective sport or activity.

7. A pulse rate monitor according to any foregoing claim wherein the output device includes a voice synthesiser and a loudspeaker.

8. A pulse rate monitor according to claim 7 wherein the data storage device is adapted to store at least one voice sample.

9. A pulse rate monitor according to any foregoing claim where the data storage device is adapted to store at least one user identifier.

10. A pulse rate monitor according to any foregoing claim wherein the monitor further includes a rechargeable battery and an inductive charging device connected thereto.

11. A pulse rate monitor according to any foregoing claim wherein the monitor further includes an external housing, the housing being sealed against water ingress.

12. A pulse rate monitor according to any foregoing claim wherein the external housing is adapted to be fitted to the human ear.

13. A pulse rate monitor according to any foregoing claim further including a pedometer or accelerometer for automatic calculation of distance moved by a user.

14. A pulse rate monitor according to any foregoing claim further including a global positioning system receiver for monitoring of distance and altitude.

15. A pulse rate monitor according to any foregoing claim further comprising a receiver for receiving a signal from a wireless entertainment system.

16. A pulse rate monitor according to any foregoing claim in combination with a base station therefor, the base station comprising a second data transfer device for communicating with the sensor in the monitor.

17. The combination of claim 16 wherein the second data transfer device includes an emitter for communicating with the detector of the pulse rate monitor to upload data to the pulse rate monitor from the base station and a detector for communicating with the emitter of the pulse rate monitor to download data from the pulse rate monitor to the base station.

18. The combination of claim 17 wherein the emitter and detector of the second data transfer device are electro-optical, and form a module for cooperating with the sensor of the pulse rate monitor.

19. The combination of claim 18 wherein the module is adapted to fit between the detector and emitter of the pulse rate monitor.

20. The combination of any one of claims 16 to 19 wherein the base station has controls for the adjustment of operational parameters of the pulse rate monitor.

21. The combination of claim 20 wherein the controls are adapted to adjust at least one of an output volume, voice output rate or user identification of the pulse rate monitor.

22. The combination of any one of claims 16 to 21 wherein the base station includes a memory to store a logged pulse rate history from the pulse rate monitor.

23. The combination of any one of claims 16 to 22 wherein the base station includes a display device to display a logged pulse rate history from the pulse rate monitor.

24. The combination of any one of claims 16 to 23 wherein the base station includes a voice file generator for storing voice files for transmission to the pulse rate monitor.

25. The combination of claim 24 wherein the voice file generator is adapted to record voice files.

26. The combination of any one of claims 16 to 25 wherein the base station is adapted to communicate pulse rate data to a computer.

27. The combination of any one of claims 16 to 26 wherein the base station includes a charging device for charging the battery of the pulse rate monitor.

28. A pulse rate monitor for detecting the pulse rate of a body part of a user, the monitor including a sensor comprising an emitter and a detector, the emitter being adapted

to emit an output signal which in use is incident on the body part and the detector being adapted to receive a signal which, in use, is transmitted through and/or reflected from the body part, the received signal being modulated relative to the output signal dependent on the pulse rate of the body part, an output device for communicating the pulse rate to a user, a programmable data storage device for storing operational parameters of the pulse rate monitor and a data transfer device for transferring data to the data storage device from an external unit whereby the operation of the pulse rate monitor can be selectively programmed by a user.

29. A pulse rate monitor according to claim 28 wherein the data transfer device is connected between the data storage device and the sensor, and is adapted to transfer data via the sensor between the data storage device and an external unit.

30. A pulse rate monitor according to claim 29 wherein the data transfer device is adapted to download data from the pulse rate monitor to the external unit via the emitter and to upload data to the pulse rate monitor from the external unit via the detector.

31. A pulse rate monitor according to claim 29 or claim 30 wherein the emitter is an electro-optical emitter and the detector is an electro-optical detector.

32. A pulse rate monitor according to any one of claims 28 to 31 wherein the data storage device is adapted to store a past history of measured pulse rate measured on a user.

33. A pulse rate monitor according to any one of claims 28 to 32 wherein the data storage device is adapted to store at least one training program.

34. A pulse rate monitor according to claim 33 wherein the at least one training program is specific to a respective sport or activity.

35. A pulse rate monitor according to any one of claims 28 to 34 wherein the output device includes a voice synthesiser and a loudspeaker.

36. A pulse rate monitor according to claim 35 wherein the data storage device is adapted to store at least one voice sample.

37. A pulse rate monitor according to any one of claims 28 to 36 where the data storage device is adapted to store at least one user identifier.

38 A pulse rate monitor according to any one of claims 28 to 37 wherein the monitor further includes a rechargeable battery and an inductive charging device connected thereto.

39. A pulse rate monitor according to any one of claims 28 to 38 wherein the monitor further includes an external housing, the housing being sealed against water ingress.

40. A pulse rate monitor according to any one of claims 28 to 39 wherein the external housing is adapted to be fitted to the human ear.

41. A pulse rate monitor according to any one of claims 28 to 40 further including a pedometer or accelerometer for automatic calculation of distance moved by a user.

42. A pulse rate monitor according to any one of claims 28 to 41 further including a global positioning system receiver for monitoring of distance and altitude.

43. A pulse rate monitor according to any one of claims 28 to 42 further comprising a receiver for receiving a signal from a wireless entertainment system.

44. A pulse rate monitor according to any one of claims 28 to 43 in combination with a base station therefor, the base station comprising a second data transfer device for communicating with the sensor in the monitor.

45. The combination of claim 44 wherein the second data transfer device includes an emitter for communicating with the detector of the pulse rate monitor to upload data to the pulse rate monitor from the base station and a detector for communicating with the emitter of the pulse rate monitor to download data from the pulse rate monitor to the base station.

46. The combination of claim 45 wherein the emitter and detector of the second data transfer device are electro-optical, and form a module for cooperating with the sensor of the pulse rate monitor.

47. The combination of claim 46 wherein the module is adapted to fit between the detector and emitter of the pulse rate monitor.

48. The combination of any one of claims 44 to 47 wherein the base station has controls for the adjustment of operational parameters of the pulse rate monitor.

49. The combination of claim 48 wherein the controls are adapted to adjust at least one of an output volume, voice output rate or user identification of the pulse rate monitor.

50. The combination of any one of claims 44 to 49 wherein the base station includes a memory to store a logged pulse rate history from the pulse rate monitor.

51. The combination of any one of claims 44 to 50 wherein the base station includes a display device to display a logged pulse rate history from the pulse rate monitor.

52. The combination of any one of claims 44 to 51 wherein the base station includes a voice file generator for storing voice files for transmission to the pulse rate monitor.

53. The combination of claim 52 wherein the voice file generator is adapted to record voice files.

54. The combination of any one of claims 44 to 53 wherein the base station is adapted to communicate pulse rate data to a computer.

55. A pulse rate monitor substantially as hereinbefore described with reference to the accompanying drawings.

56. Use of a pulse rate monitor according to any foregoing claim for monitoring the pulse rate of a human or an animal such as a horse, e.g. a racehorse.

57. The combination of a pulse rate monitor and a base station therefor substantially as hereinbefore described with reference to the accompanying drawings.

Application No:	GB 0309480.2	**Examiner:**	Eleanor Hogan
Claims searched:	1-27 & 55-57.	**Date of search:**	10 November 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X, Y	X. 1-3, 16-48, 20, 22, 23 & 56 at least. Y 4-13 & 15 at least	EP 0759284 A2	(SEIKO) see abstract, col. 9 line 58 - col. 10 line 17, col. 11 line 25-42, col. 20 line 56 - col. 22 line 26 and figs. 8, 11 & 21.
Y	7,12 & 15 at least	US 6080110 A	(THORGERSEN) see especially abstract and fig. 2.
Y	4-9 & 12 at least.	EP 0172747 A2	(NIPPON KOKAN KK) see abstract.
Y	13.	EP 1297784 A1	(C S E M CENTRE SUISSE) see abstract.
Y	10 & 11	US 3867950 A	(FISCHELL) see abstract.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category	P	Document published on or after the declared priority date but before the filing date of this invention
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

G1A

Worldwide search of patent documents classified in the following areas of the IPC[7]

A61B; G08C.

The following online and other databases have been used in the preparation of this search report:

EPODOC, WPI, PAJ.